Modeling the Diffraction Efficiencies of the AXAF High Energy K. A., Transmission Gratings Above 2 keV	X8A

K.A. Flanagan, T.T Fang, C. Baluta, J.E. Davis, D. Dewey, T.H. Markert (MIT); D.E. Graessle, J. Drake, J. E. Fitch, J.Z. Juda, J. Woo (SAO); J. Bauer (U. of Hawaii)

The High Energy Transmission Grating Spectrometer (HETGS) is a high-spectral resolution instrument which includes 336 individual transmission grating elements. It is designed to fly aboard the Advanced X-ray Astrophysics Facility (AXAF), a NASA X-ray observatory scheduled for launch in 1998. The gratings of the HETGS are of two types. High energy gratings (HEGs) have a 2000 Angstrom period and an average bar height of 0.52 microns, with a line/period ratio of 0.6. Medium energy gratings (MEGs) have a 4000 Angstrom period and an average bar height of 0.37 microns, with a line/period ratio of 0.52. The calibration approach relies on synchrotron radiation (SR) tests of a few gratings to establish the validity and accuracy of the physical model we use. The model uses scalar diffraction theory, and considers the period, height, width, shape and tilt of the grating bar, as well as absorption by the polyimide support structure and the plaring base materials. The goal of the modeling is to obtain efficiencies accurate to the 1% level, except near absorption edges where the requirement is at the level of 5% to 10%. Gratings that have been tested at the SR facilities are then used as transfer standards in laboratory X-ray tests of each individual grating element, to minimize systematic errors and allow normalization against a known efficiency. We present here the results of a series of new SR tests performed at NSLS in October, 1995. These (and other) results are detailed in Flanagan, et al, SPIE Proceedings vol. 2808, 1996. One MEG grating (MA2047) and one HEG grating (HA2021) were tested. Both of these gratings were from AXAF flight lots. The focus was on a dense sampling of zeroth and first order diffraction efficiencies over most of the NSLS energy range of beamline X8A. The data and results of our model fitting for grating HA2021 is presented in Figures 1 and 2, where the first and zeroth diffraction orders were fit simulatneously. Analogous results apply to the NSLS data for grating MA1047. Note that, for much of the energy region, the residuals are generally within the calibration goal. Future work will include modeling with data from higher orders (obtained at NSLS in March, 1996) and data from PTB at energies below 2 keV. We plan to explicitly take into account edge structure as we pursue modeling in this energy region.
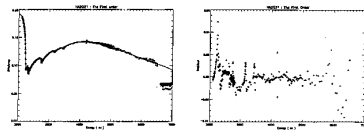

Figure 1. Best fit model and residuals for the first order NSLS data of grating HA2021 when both the first and the zeroth diffraction orders are fit simultaneously. Wing corrections have been included. Residuals scale: -4% to +6%.
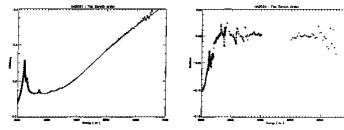
Figure 2. Best fit model and residuals for the zeroth order NSLS data of grating HA2021 when both the first and the zeroth diffraction orders are fit simultaneously. Wing corrections have been included. Residuals scale: -15% to +5%.